

OPPORTUNITIES TO HELP TINNITUS PATIENTS

Richard S. Tyler, Ph.D.

THE MECHANISMS OF TINNITUS

According to Tyler and Babin (1986), Tinnitus can be classified similar to hearing loss as:

- Middle-ear tinnitus
- Sensorineural tinnitus
- Central tinnitus

It has long been appreciated that wherever tinnitus originates, it must be perceived in the auditory cortex based on the following:

- “Sectioning the auditory nerve is often ineffective in reducing tinnitus.”
- “Masking can be just as effective in the ear ipsilateral to the tinnitus as in the ear contralateral to the tinnitus.”
- “One can observe that a person who is convinced about hearing tinnitus in the right ear can suddenly hear the tinnitus in the left ear when the right-ear tinnitus is masked.” (Tyler, 1981; Tyler & Conrad-Armes, 1984)

Preece, Tyler and Noble (2003) summarized three ways that tinnitus is coded in the cortex:

- An increase in neural spontaneous activity in the cortex might be the result of different types of abnormalities in lower parts of the auditory system. For example, a decrease in activity in an inhibitory neuron could be the cause. Alternatively, an “edge effect” between normal activity and a decrease in activity might create an emphasis at the edge due to lack of

inhibition (Kiang, Moxon & Levine, 1970).

- High correlation among nerve fibers in their spontaneous activity (Eggermont, 1984).
- More fibers with similar best frequencies following plasticity after peripheral hearing loss (Salvi et al., 2000).

MEASURING TINNITUS

It is critical to distinguish the tinnitus itself from the reaction to it. You might not be able to change someone’s tinnitus, but you can often help him or her change the reaction. If you are trying to reduce the tinnitus, for example, with a drug, you should measure the magnitude of the tinnitus. If you are attempting to change someone’s reactions, for example, with counseling, you should measure a person’s reactions.

The magnitude and quality of tinnitus

The quality of the tinnitus can be described by what it sounds like or the most prominent pitch of the tinnitus (Stouffer, Tyler, Kileny & Dalzell, 1991). The loudness of a tone can be adjusted to the loudness of the tinnitus, and the level of a broadband noise can be adjusted until it just masks the tinnitus, the Minimum Masking Level (MML) (Tyler, 2000; Henry et al., 2004; 2006). The MML cannot be measured in everyone because in some the tinnitus cannot be masked. Caution should also be exercised because the masking noise can make tinnitus worse in some patients.

The reactions to tinnitus

Several research groups have documented the wide variety of reactions people have to their tinnitus (Erlandsson, 2000; Andersson & Kaldo, 2006; Henry & Wilson, 2001; McKenna, 2000). Dauman and Tyler (1992) proposed a model suggesting that the annoyance from tinnitus was influenced both by its magnitude and quality, and modified by the psychological makeup of the patient. "Patients with soft tinnitus are likely not under as much stress as patients who report a loud tinnitus," suggest Stouffer and Tyler (1990). We categorize these reactions as influencing:

- Thoughts and emotions
- Hearing
- Sleep
- Concentration

Several questions have been developed for quantifying tinnitus handicap (see Tyler, 1993, for a review). The Tinnitus Handicap Inventory uses a three-label (yes, sometimes, no) category scale (Newman, Jacobson & Spitzer, 1996). This can render it insensitive to changes (Tyler, Noble & Coelho, 2006). The Tinnitus Functional Index represents an advantage over the Tinnitus Handicap Inventory, as it includes a 0–10 scale (Miekle et al., 2012). We prefer the Tinnitus Handicap Questionnaire, as it uses a 0–100 scale, which results in better sensitivity to measuring changes (Kuk, Tyler, Russell & Jordan, 1990). Most patients will use 0, 1, 5, 10, 15, 20, ..., 100, resulting in a 21-level scale.

Our questionnaires have been translated into many languages and can be downloaded for free at

www.uihealthcare.org/Tinnitus/
or
**[www.uihealthcare.com/depts/med/
otolaryngology/clinics/tinnitus/index.html](http://www.uihealthcare.com/depts/med/otolaryngology/clinics/tinnitus/index.html)**

We welcome new translations, and if you would like to share please contact me at rich-tyler@uiowa.edu.

We have also developed a new questionnaire, the Tinnitus Primary Disabilities Questionnaire, which we formerly called the Tinnitus Activities Questionnaire (Tyler et al., 2009). This new questionnaire has the sensitivity advantage of the 0–100 percent and intentionally avoids questions related to the "quality of life." Such questions, we believe, are likely to make the questionnaire insensitive to treatment changes focused on primary disabilities.

COUNSELING WITH TINNITUS ACTIVITIES TREATMENT

As with hearing aids, it is important to "nurture the expectations" of the patient, including:

- Being perceived as a knowledgeable professional
- Demonstrating that you understand tinnitus
- Providing a clear therapy plan
- Being sympathetic
- Showing that you sincerely care
- Providing reasonable hope

(Hazell, 1987; Coles & Hallam, 1987; Tyler, Haskell, Preece & Bergan, 2001)

A variety of counseling procedures have evolved from the work of Hallam (1989), Coles and Hallam (1987) and Hazell (1987). This was closely followed by the application of cognitive behavior therapy to tinnitus (Sweetow, 2000; Henry & Wilson, 2001; 2002). Our own counseling strategies began from our early observations of the variety of problems experienced by tinnitus patients (Tyler & Baker, 1983). We noted that "counseling needs to consider all of the patient's difficulties" and that "the major emphasis of counseling should address the emotional problems related to the tinnitus." This led to our approach to tinnitus counseling (Tyler & Babin, 1986; Tyler, Stouffer & Schum, 1989; Stouffer et al., 1991).

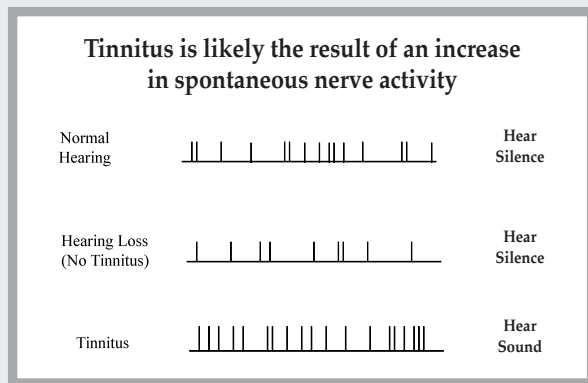


Figure 1: Example from the module on Thoughts and Emotions. A schematic representation of the coding of sounds and how tinnitus might be represented in the brain.

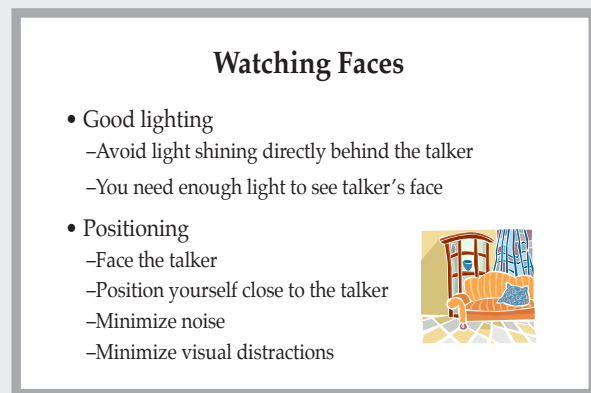


Figure 2: Example from the module on Hearing. An example of strategies to improve communication.

We now call this **Tinnitus Activities Treatment**, which is collaborative and adapted to the individual (Tyler et al., 2006). The pictures that are shared with the patients are available for free at

www.uihealthcare.org/Tinnitus/
or
www.uihealthcare.com/depts/med/otolaryngology/clinics/tinnitus/index.html

Thoughts and emotions

A first step is to make sure the patient understands what tinnitus is, what causes it, and what treatments are and are not available. The way patients think about their tinnitus influences how they react to it. Patients are told they cannot change the tinnitus, but they can change the way they react to it. Aspects of cognitive behavior therapy are often very helpful here (Henry & Wilson, 2001). It is the responsibility of the clinician to help patients learn how to change their reactions. Figure 1 shows an example of one figure utilized in the section called thoughts and emotions.

Hearing

Tinnitus can also interfere with hearing. Many of the aural rehabilitation strategies used with hearing aid patients should also be helpful with tinnitus. For example, the following strategies are often helpful:

- Let people know you have difficulty hearing and ask them to speak clearly.
- Look at the talker's mouth; lipreading is difficult, but it can help all of us.

- When you don't understand, ask the talker for clarification and be specific (e.g., I heard you say, "... went to the store ..." but that's all.)
- Move close to the speaker, so you can see his or her face.
- Turn off noise sources if possible or move away from the noise.

Figure 2 shows an example of one figure utilized in the section on hearing.

Sleep

Difficulty sleeping is one of the most common complaints. Strategies to facilitate sleep include:

- Avoiding caffeine, tobacco and large meals before bedtime.
- Creating a bedroom that will promote sleep by ensuring that your bedding is comfortable and removing all items that might distract you from sleeping.
- Maintaining a consistent sleep and wake-up schedule.
- Exploring relaxation strategies, such as imagery training and progressive muscle relaxation, and using them before bed and during the night when sleep problems arise.

Playing low-level music or environment sounds is often used to help tinnitus patients get to sleep. There are many recordings available to help people sleep, and you can help your patients choose

Preparing for Sleep Using Sound

- Choose soft pleasant sounds you enjoy
 - Music (calm, soothing, steady, classical, piano)
 - Sounds of nature (waves, waterfalls, raindrops)
 - Broadband noise (“ssshhh”)

Figure 3: Example from the module on Sleep. Strategies to use sound to assist with sleeping.

3. Strategies to Improve Concentration

- A. Eliminate distractions
- B. Adjust work habits
- C. Stay focused
- D. Consider task difficulty
- E. Decrease prominence of tinnitus
- F. Take control of your attention

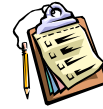


Figure 4: Example from the module on Concentration. An introduction picture to explain, followed by options to be discussed about improving concentration.

something that works for them. We suggest that the patients leave sound on all night. Figure 3 shows an example of one figure utilized in the section on sleep.

Concentration

Concentration is important for completing most tasks. Those who are unable to focus because of their tinnitus can become frustrated and take longer to complete activities. Strategies for improving concentration involve reducing distractions that are interfering. Figure 4 shows an example of one figure utilized in the section on concentration. Some things to consider include the following:

- Choose a comfortable and distraction-free environment.
- Avoid being tired when you need to concentrate.
- Use low-level background sound to decrease the prominence of your tinnitus.
- Take breaks.
- Stay engaged by taking notes, organizing the information and asking questions.

SOUND THERAPIES

Background sound has been used for decades to help tinnitus (Vernon, 1977; Bentler & Tyler, 1987; Tyler & Bentler, 1987; Hazell, 1987; Henry, Zaugg & Schechter, 2005). Its role can be:

- Reducing the attention drawn to the tinnitus.
- Reducing the loudness of the tinnitus.
- Substituting an unpleasant sound (the tinnitus) with a less disruptive one (the background sound).
- Giving the patient some control over his or her tinnitus (Vernon, 1977; Coles & Hallam, 1987).

Because background sound can sometimes result in an increase in the tinnitus, Tyler and Bentler (1987) suggested:

- Occasional rest from noise.
- Changing the level or spectrum of the noise.

We also suggested limiting the influence of noise on speech or everyday sound perception by:

- Using low-level noise in the region of 500 – 3000 Hz.
- Using a unilateral sound generator when appropriate.

Hearing aids

Many clinicians have noted the benefit of hearing aids (Vernon & Schleuning, 1978; Bentler & Tyler, 1987; Melin, Scott, Lindberg & Lyttkens, 1987; Kochkin, Tyler & Born, 2011). Folmer et al. (2006) and Searchfield (2008) provide detailed strategies for fitting hearing aids for tinnitus patients. Some helpful hints include:

- Trying a hearing aid before a masker, as the hearing aid can often help the tinnitus as well as improve hearing.
- Use an open earmold to allow natural sounds from the environment to partially mask the tinnitus.
- Use more gain at low input levels than at high input levels to further increase the effectiveness of low-level sounds to partially mask the tinnitus.
- If hyperacusis is present, initially set the maximum output to a lower level.
- If loud sounds make the tinnitus worse, initially set the maximum output to a lower level.

Background sound

Vernon and Schleuning (1978) were likely the first to recommend the use of wearable devices that produced broadband noise to mask the tinnitus. Vernon cautioned that the noise level should be under the control of the patient (Vernon & Meikle, 2000). Although total masking was often used in the early years, our work indicated that a total masking approach was too loud for many patients, and sometimes made the tinnitus worse (Tyler & Baker, 1983; Stouffer & Tyler, 1990; Hazell, 1987). Therefore, we recommended noise that did not completely mask the tinnitus — or “partial masking” (Tyler & Bentler, 1987; Bentler & Tyler, 1987; Folmer et al., 2006).

Table 1 reviews several sound therapies that have promoted partial masking, together with the instructions provided to the patient.

Coles and Hallam (1987) suggested that “the masker can be turned up until its loudness is equal to that of the tinnitus, when the patient will often have to listen hard to hear the tinnitus” (p. 398). Jastreboff (2000) later referred to this as the “mixing point” (see also Bartnik & Skaryski, 2008). This is also partial masking, where the sound level is similar to the magnitude of the tinnitus.

In the last five years or so there have been many new, wearable sound stimuli devices available for tinnitus. These range from soft background processes, music, or shaped noise to modulated

tonal complexes. Different patients have different individual preferences. Many benefit from and purchase sound therapy devices.

SELF HELP FOR TINNITUS

We have categorized patients according to their needs (Tyler & Erlandsson, 2003). Many patients who are simply “curious” about their tinnitus can benefit from brochures (Sizer & Coles, 2006; Tyler, 2008). For patients who are “distressed,” there are some excellent self-help tinnitus books (Davis, 1995; Henry & Wilson, 2002; Tyler, 2008).

Tyler & Babin, 1986	“Both the noise and tinnitus are heard but the tinnitus is reduced in loudness.” Patients should “use the lowest level masker that provides adequate relief.”
Coles & Hallam, 1987	“Partial masking ... a low level background sound against which the loudness of the tinnitus is reduced.”
Erlandsson et al., 1992	Reduced the noise from the complete masking condition until it was “comfortable enough to listen to.”
Hazell, 1987	“The masking sound does not completely cover the tinnitus” and then it provides a “distracting background sound” (p. 107). The “tinnitus tends to ‘break through’ the masking noise” (p. 112).
Coles, 1987	“That is when the masker is used to provide only a low level of background sound against which the loudness of the tinnitus is reduced” (p. 398).
Tyler & Bentler, 1987	“Sometimes a masker can reduce the tinnitus loudness or annoyance, even though the tinnitus remains audible.” “Partially mask the tinnitus yet produce the lowest SPLs and the least interference with speech.”
Bentler & Tyler, 1987	“Urge the patient to use the lowest level of masker level that provides adequate relief” (p. 30).

Table 1: Examples of descriptions of partial masking (adapted from Tyler, 2008).

TINNITUS AND HYPERACUSIS

Many patients with tinnitus also experience loudness hyperacusis (Tyler & Conrad-Armes, 1983). That is, they perceive sounds that would normally be loud as being very loud (Formby & Gold, 2002). Hyperacusis has been described in many ways. We (Tyler et al., 2009) categorize hyperacusis as three types:

- Loudness hyperacusis
- Annoyance hyperacusis
- Fear hyperacusis (phonophobia)

Some treatment options are reviewed by Baguley and Andersson (2007), Tyler et al. (2009), and Formby and Gold (2002). Generally, controlled exposure to low-level sound over several weeks or months can be helpful. We have also recorded sounds that create hyperacusis and let patients listen to them at lower levels in situations that they can control.

CONCLUSIONS

There are now great opportunities to help tinnitus patients. More professionals need to be providing tinnitus services along with diagnostics and the dispensing of hearing aids.

REFERENCES

- Andersson, G. & Kaldo, V. (2006). Cognitive Behavioral Therapy with Applied Relaxation. *Tinnitus Treatment: Clinical Protocols* (pp. 96-115). (Ed. Tyler, R.S.) New York: Thieme.
- Baguley, D.M. & Andersson, G. (2007). *Hyperacusis: Mechanisms, diagnosis, and therapies*. San Diego: Plural Publishing Inc.
- Bartnik, G. & Skaryski, H. (2008). *Tinnitus Treatment: Clinical Protocols*. (Ed. Tyler, R.S.) New York: Thieme.
- Bentler, R.A. & Tyler, R.S. (1987). Tinnitus management. *ASHA*, 27–32.
- Coles, R.R. (1987). *Tinnitus and its Management*. (Ed. Stephens, S.D.G., Kerr, A.G.) Guilford, U.K.: Butterworth, p.398.
- Coles, R.R. & Hallam, R.S. (1987). Tinnitus and its management. *British Medical Bulletin*, 43(4), 983–98.
- Dauman, R. & Tyler, R.S. (1992). Some considerations on the classification of tinnitus. Tinnitus 91: Proceedings of the Fourth International Tinnitus Seminar, Bordeaux, France. August 27-30, 1991. J. Aran and R. Dauman. Amsterdam, Kugler: 225–29.
- Davis, P. (1995). *Living with tinnitus*. Rushcutters Bay, N.S.W.: Gore & Osment.
- Eggermont, J.J. (1984). Tinnitus: some thoughts about its origin. *Journal of Laryngology & Otolaryngology*, 9, 31–37.
- Erlandsson, S. (2000). *Tinnitus Handbook*. (Ed. Tyler, R.S.) San Diego: Singular.
- Erlandsson, S.I., Hallberg, L., & Axelsson, A. (1992). Psychological and audiological correlates to perceived tinnitus severity. *Audiology*, 31, 168-179.
- Folmer, R.L., Martin, W.H., Yongbing, S., & Edlefsen, L.L. (2006). *Tinnitus Treatment: Clinical Protocols*. (Ed. Tyler, R.S.) New York: Thieme, pp. 51–64.
- Formby, C. & Gold, S.L. (2002). Modification of loudness discomfort levels: Evidence for adaptive chronic auditory gain and its clinical relevance. *Seminars in Hearing*, 23(1), 21–34.
- Hallam, R.S. (1989). *Living with tinnitus: Dealing with the ringing in your ears*. Wellingborough, Northamptonshire, Thorsons.
- Hazell, J.W.P. (1987). Tinnitus Masking Therapy. In: Hazell, J.W.P. *Tinnitus*. London; Churchill Livingstone, pp. 96-117.
- Henry, J.A., Rheinsburg, B., Owens, K.K., & Ellingson, R.M. (2006). New instrumentation for automated tinnitus psychoacoustic assessment. *Acta Oto-Laryngologica*, 126, Suppl. 556, 34–38.
- Henry, J.A., Rheinsburg, B., et al. (2004). Computer-automated tinnitus assessment using patient control of stimulus parameters. *Journal of Rehabilitative Research & Development* 41(6), 871–88.
- Henry, J.A., Zaugg, T.L., & Schechter, M.A. (2005). Clinical guide for audiologic tinnitus management II: Treatment. *American Journal of Audiology*, 14, 49–70.
- Henry, J.L. & Wilson, P.H. (2001). *The Psychological Management of Chronic Tinnitus: A Cognitive-Behavioral Approach*. Allyn & Bacon Publishers.
- Henry, J.L. & Wilson, P.H. (2002). *Tinnitus: A Self-Management Guide for the Ringing in Your Ears*. Allyn & Bacon Publishers.
- Jastreboff, P.J. (2000). Tinnitus Habituation Therapy (THT) and Tinnitus Retraining Therapy (TRT). *Handbook of Tinnitus*. (Ed. Tyler, R.S.) San Diego: Singular Publications.
- Kiang, N.Y.S., Moxon, E.C., & Levine, R.A. (1970). Auditory-nerve activity in cats with normal and abnormal cochleas. Ciba Symposium on Sensorineural Hearing Loss (Churchill, London).
- Kochkin, S., Tyler, R.S., & Born, J. (2011). MarkeTrak VIII: Prevalence of Tinnitus and Efficacy of Treatments, *The Hearing Review*, 18(12), 10–26.
- Kuk, F.K., Tyler, R.S., Russell, D., & Jordan, H. (1990). The psychometric properties of a tinnitus handicap questionnaire. *Ear & Hearing*, 11(6), 434–42.
- McKenna, L. (2000). Tinnitus and Insomnia. *Tinnitus Handbook*. (Ed. Tyler, R.S.) San Diego: Singular, pp. 59–84.
- Meikle, M.B., et al. (2012) The Tinnitus Functional Index: Development of a New Clinical Measure for Chronic, Intrusive Tinnitus. *Ear & Hearing*, 33, (2) 153–76.
- Melin, L., Scott, B., Lindberg, P., & Lyttkens, L. (1987). Hearing aids and tinnitus—an experimental group study. *British Journal of Audiology*, 21(2), 91–7.
- Newman, C.W., Jacobson, G.P., & Spitzer, J.B. (1996). Development of the Tinnitus Handicap Inventory, *Archives of Otolaryngology — Head & Neck Surgery*, 122(2), 143–48.
- Preece, J.P., Tyler, R.S., & Noble, W. (2003) The Management of Tinnitus. *Geriatrics & Aging*, 6(6), 22–28.

- Salvi, R.J., Lockwood, A., & Burkard, R. (2000). Neural plasticity and tinnitus. *Tinnitus Handbook*. (Ed. Tyler, R.S.) San Diego: Singular Pub. Group, pp. 123–48.
- Searchfield, G.D. (2008). *The Handbook on Tinnitus*. (Ed. Tyler, R.S.) Sedona, AZ: Auricle Ink Publishers.
- Sizer, D.I. & Coles, R.R.A. (2006). Tinnitus Self-Treatment. *Tinnitus Treatment: Clinical Protocols*. (Ed. Tyler, R.S.) New York: Thieme, pp. 23–28.
- Stouffer, J.L. & Tyler, R.S. (1990). Characterization of tinnitus by tinnitus patients. *Journal of Speech and Hearing Disorders*, 55(3), 439–53.
- Stouffer, J.L., Tyler, R.S., Kileny, P., & Dalzell, L. (1991). Tinnitus as a function of duration and etiology: Counseling implications. *American Journal of Otology*, 12(3), 188–94.
- Sweetow, R. (2000). Cognitive Behavior Therapy for Tinnitus. *Tinnitus Handbook*. (Ed. Tyler, R.S.) San Diego, CA: Singular Publishing Group.
- Tyler, R.S. (1981). Invited discussant. Tinnitus, Ciba Foundation Symposium 85: Pitman.
- Tyler, R.S. (1993). Tinnitus disability and handicap questionnaires. *Seminars in Hearing*, 14(4), 377–384.
- Tyler, R.S. (2000). The psychoacoustical measurement of tinnitus. (Ed. Tyler, R.S.) *Tinnitus Handbook*, pp. 149–179. San Diego, CA: Singular Publishing Group.
- Tyler, R.S. (2008). *The Consumer Handbook on Tinnitus*. (Ed. Tyler, R.S.) Auricle Inc., Sedona.
- Tyler, R.S. & Babin, R.W. (1986). Tinnitus. (Ed. Cummings, C.W., Fredrickson, J.M., Harker, L., Krause, C.J., and Schuller, D.E.) *Otolaryngology-Head and Neck Surgery*, pp. 3201–3217.
- Tyler, R.S. & Baker, L.J. (1983). Difficulties experienced by tinnitus sufferers. *Journal of Speech and Hearing Disorders*, 48(2), 150–154.
- Tyler, R.S. & Bentler, R.A. (1987). Tinnitus maskers and hearing aids for tinnitus. (Ed. Sweetow, R.), *Seminars in Hearing*, 8(1), 49–61. Thieme Medical Publishers, New York.
- Tyler, R.S. & Conrad-Armes, D. (1983). The determination of tinnitus loudness considering the effects of recruitment. *Journal of Speech and Hearing Research*, 26(1), 59–72.
- Tyler, R.S. & Conrad-Armes, D. (1984). Masking of tinnitus compared to masking of pure tones. *Journal of Speech and Hearing Research*, 27(1), 106–111.
- Tyler, R.S. & Erlandsson, S. (2003). Management of the tinnitus patient. (Ed. Luxon, L.M., Furman, J.M., Martini, A., and Stephens, D.) *Textbook of Audiological Medicine*, pp. 571–578. London, England: Taylor & Francis Group.
- Tyler, R.S., Gehringer, A.K., Noble, W., Dunn, C.C., Witt, S.A., & Bardia, A. (2006). Tinnitus activities treatment. *Tinnitus treatment: Clinical protocols*. (Ed. Tyler, R.S.) New York: Thieme, pp. 116–31.
- Tyler, R.S., Haskell, G., Preece, J., & Bergan, C. (2001). Nurturing patient expectations to enhance the treatment of tinnitus. *Seminars in Hearing*, 22, 15–21.
- Tyler, R.S., Noble, W., Coelho, C., Haskell, G., & Bardia, A. (2009). *Tinnitus and Hyperacusis*. (Ed. Katz, J., Burkard, R., Medwetsky, L., Hood, L.). Handbook of Clinical Audiology, Sixth Edition. Baltimore: Lippincott Williams & Wilkins.
- Tyler, R.S., Noble, W.G., & Coelho, C. (2006). Considerations for the Design of Clinical Trials for Tinnitus. *Acta Oto-Laryngologica*, 126, 44–49.
- Tyler, R.S., Stouffer, J.L., and Schum, R. (1989). Audiological rehabilitation of the tinnitus client. *Journal of the Academy of Rehabilitative Audiology*, 22, 30–42.
- Vernon, J. (1977). Attempts to relieve tinnitus. *J Am Audiol Soc* 2(4): 124–31.
- Vernon J.A. & Meikle, M.B. (2000). Tinnitus Masking. (Ed. Tyler, R.S.) *Tinnitus Handbook*, pp. 313–56. San Diego, CA: Singular Publishing.
- Vernon, J. & Schleuning, A. (1978). Tinnitus: A new management. *Laryngoscope*, 88, 413–419.



Global Headquarters
6700 Washington Avenue South
Eden Prairie, MN 55344
800.328.8602

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